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ABSTRACT

This paper looks at the ideas of R. Skemp which emphasize fostering "intelligent learning" in the teaching of mathematics. Skemp posits that schematic learning takes place when new concepts are constructed by the learner. Three modes of building such internal schema are proposed. Teachers are urged to ensure that at every stage the new concepts to be learned can be assimilated by the children's available schemas. Suggested teaching strategies include: (1) sequencing new material schematically, (2) using structured practical activities, and (3) beginning with a do-and-say approach followed by written work only when the connections between thoughts and verbal symbols are well established. (DB)

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Skemp Activities for the Intelligent Learning of Mathematics

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Mathematics, the problem subject

Once again newspapers are headlining the poor mathematics achievement of our students. The accusation is not new. Since the early 1960s there have been extensive efforts to improve the teaching of mathematics in our schools with discouraging results. Given that for almost 30 years, on both sides of the Atlantic, there have been intensive efforts by clever, hard-working, and well-funded persons, why are these problems still with us? Unless we can answer this question, at least in part, there is no reason to expect that the efforts of the next twenty years will be any more successful. But if we can find the answer, or at least a substantial part of it, the rewards will be great.

Skemp maintains that one reason for their lack of success is that most of these people have been looking in the wrong place, namely at the mathematical content of the curriculum. He believes that if the solution were to be found there, it would have been found long ago. Rather, a wider perspective is needed and he illustrates this perspective by telling the story of someone who came upon three stone masons as they worked. Asked what they were doing, one replied: "Carving stone", the second said, "Supporting my family" while the third exclaimed, "I am building a cathedral".

Needed, a wider perspective

To remedy the present poor state of mathematics education we need a wider perspective. First, we need to see it as a particularly powerful and concentrated example of the *functioning* of human intelligence. And second, as one of the most powerful and adaptable mental tools, which the intelligence of man has made for its own use, collectively over the centuries. Mathematics is a way of using our minds which greatly increases the power of our thinking. Hence its importance in today's world of rapidly advancing science, high technology and commerce.

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If children are to succeed in learning maths they need to be taught in ways which enable them to bring their intelligence, rather than rote learning, into use. And common sense alone is not enough to enable us to do this, or we would have succeeded by now. We need a theory of intelligent learning.

Implications of Skemp's model of intelligent learning for the teaching of mathematics

To attempt in one hour to summarize Skemp's model of intelligence, together with its applications for the learning of mathematics is not possible. Rather, an attempt will be made to highlight some of the most relevant aspects.

Skemp (1978) has argued that "there are two effectively different subjects being taught under the same name, 'mathematics'". He contrasts *instrumental learning (rules without reasons)* with *relational understanding (knowing both what to do and why).* Since relational and instrumental knowledge are so different, Skemp suggests that we regard them as different kinds of mathematics. Learners of any age cannot succeed at mathematics unless they learn by using their intelligence rather than by rote learning. The former follows naturally from Skemp's view that mathematics is ". . . a particularly powerful and concentrated example of the functioning of human intelligence" (1989a, p. 26). This is the kind of learning which he offers as a goal in the intelligent teaching of mathematics. The behaviourist theory which has influenced the teaching of mathematics for so many years is not without merit, but it describes those aspects of behaviour which we share with lower species. Skemp's theory describes those aspects of human learning in which we most differ from the laboratory rat or pigeon.

An essential feature of Skemp's model of intelligence is schematic learning which takes place when new concepts are *constructed by the learner.* Good teaching provides situations which encourage the schema-constructing activity of the learner and Skemp distinguishes three modes of building and testing (Skemp, 1989a, p. 74):

SCHEMA CONSTRUCTION

BUILDING	Mode	TESTING
from our own encounters with the physical world: experience	1	against expectations of events in the physical world: experiment
from the schema of others: communication	2	comparison with the schemas of others: discussion
from within, by formation of higher-order concepts: by extrapolation, imagination, intuition: creativity	3	comparison with one's own existing knowledge and beliefs: internal consistency

He goes on to explain that, "These are more powerful when used in combination, so good learning situations are those which provide opportunities for using all of these, though not necessarily in the same activity" (Skemp, 1989a, p. 87).

In order to help children build up their conceptual structures for long-term learning, it is vital that teachers try to ensure that at every stage the new concepts to be learned can be assimilated to the children's available schemas. "These ways include (a) sequencing new material schematically; (b) using structured practical activities; (c) beginning with a do-and-say approach, followed by written work only when the connections between thoughts and verbal symbols are well established" (Skemp, 1989a, p. 105).

Putting the present theory to use in the classroom

Skemp applied his theory to the classroom by producing materials for the teaching of mathematics in the form of over 340 mathematics learning activities for 5 - 11 year olds which were written and field tested over a period of eight years, and published as

Sturctured Activities for Primary Mathematics Volumes 1, 1a, 2 & 2a. He has just completed the Area network for a Measurement Unit.

It appears that in mathematics education a unique situation now exists in which a set of teaching materials has been developed in which each activity embodies not only a mathematical concept but also one or more aspects of a theory of intelligent learning.

Skemp (1989a) wrote:

> So by doing these with a group of children, both children and their teacher benefit. The children benefit by this approach to their learning of mathematics; and the teacher also has an opportunity to learn about the theory of intelligent learning by seeing it in action. Theoretical knowledge acquired in this way relates closely to classroom experience and to the needs of the classroom. It brings with it a bonus, since not only do the children benefit from this approach to mathematics, but it provides a good learning situation for teachers also. In this way we get 'two for the price of one', time-wise. (p.111)

The measurement activities which have just been developed will provide yet another opportunity for children to experience the intelligent learning of mathematics. That such learning can occur, even for those having difficulty, was nicely illustrated by a Resource Teacher in Calgary who had been doing remedial work with a group of Grade 5 students using multiplication activities from Structured Activities for Primary Mathematics. She reported that when the students' classroom teacher asked them to do some multiplication questions, they responded, "Should we do it the old way or the intelligent way?"

References

Skemp, R. (1976). Relational Understanding and Instrumental Understanding. The Arithmetic Teacher, 53 (3), 9-15.

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Skemp, R. (1989c). Structured Activities for Primary Mathematics, Volume 2. London, England: Routledge.

AVAILABLE FROM THE UNIVERSITY of CALGARY BOOKSTORE: (403) 220-5937

Skemp, R. R. (1989). Structured Activities for Primary Mathematics, **Volumes 1, 1a, 2, 2a.** London: Routledge.

Volume 1	(K-2)	224 pages of activities	UofC Bookstore
Volume 1a	(K-2)	192 photo-masters	UofC Bookstore
Volume 2	(3-6)	256 pages of activities	UofC Bookstore
Volume 2a	(3-6)	192 photo-masters	UofC Bookstore

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Skemp, R. R. (1979). Intelligence, Learning, and Action. Chichester: Wiley.

SKEMP VIDEOCASSETTES AVAILABLE FROM COM/MEDIA, THE UNIVERSITY OF CALGARY: (403) 220-3709

Contact COM/MEDIA for a complete listing. The videocassettes include Skemp introducing activities to groups of children, Skemp responding to questions about his theory, and Classroom Management Techniques.